Forensic Genetics: its application in Criminal Law

SHORT SYNOPSIS

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DECLARATION BY THE SCHOLAR

I hereby declare that the shortsynopsis"Forensic Genetics: its application in criminal law" beingsubmitted in partial fulfilment of the requirement for the degree of Doctor of Philosophy in department of Law under Faculty of Law of Manav Rachna University, Faridabad during the academic year 2019-2020.

It is a bona-fide record of original work carried out under the supervision of Dr.Somdutt Bhardwaj and has not been submitted in full or part to anyother university or institute for degree or diploma. Further, it is certified that short synopsis is within the plagiarism limit and copy of the same is attached as per Universitynorms.

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This is to certify that, the short synopsis entitled "Forensic Genetics: its application in criminal law" is an original piece of work done by research scholar Abhinav Vardhan Sharma under the supervision of Dr. Somdutt Bhardwaj for the degree of Doctor of Philosophy in the Department of Law under the Faculty of Law of Manav Rachna University, Faridabad during the academic year 19-20

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Contents

S No.		Page No.
1	Introduction	1-4
1.1	Defining Genome	4-6
1.2	Genetics and Criminal Law	6
1.3	Problem of the study	6
1.4	Aims and Objectives	6
1.5	Hypothesis	7
1.6	Research Questions	7
1.7	Research Methodology	7
2	Literature Review	8-16
3	Tentative chapterization	17
4	References	18-20

Abstract

Genetics is generally used as a multidisciplinary science approach to address the challenges of legal arena. Genetics is a young science. The *actus reus* and *mens rea* are thought to have a correlation with certain genetic factors and that information can be taken out with the use of science of genomics. 'Behavioural genetics', a term if applied and studied properly can lead to reduced criminal activities and in turn India can come up as a safe place to live in. Forensic genetics now not only related to the DNA fingerprinting but taken up the next level by designing the 3d face models by the information taken out by certain cells only. The question of privacy concerns and the ethical issues that can arise because of this technology also require to be answered from the angle of law.

The purpose of this study is to find out the possible answers to these issues keeping in mind the limitations and the requirement of regulations for the hidden issues that can come up with the advancements in the field of criminology.

Key Words: DNA, RNA, gene, GINA, HIPPA and GMOs.

Chapter I: Introduction

1. Introduction

On 8th Dec 2009 the first Indian genome was announced. Indigen genome project is working in India for the objective to enable sequencing of thousands of genomes representing ethnic groups of India and to use those genomes in public health[1]. Genetics is a very young science. It can be described as a multidisciplinary team's scientific approach for the benefit of big challenges faced by society at large using extensive study of genome. The genetics intersects with the law on various fronts such as criminal law, forensics, law related to intellectual property rights, tort law and privacy law. The genetics also involves legal and ethical issues as well which are decisive factor in policy making of a country. The question now arises that what is gene, genome, and genetics?

1.1.1 Defining the term Gene

Mendel was the first scientist who laid the foundation of genetics in year 1866. He worked on the heredity behaviour, physical factors and underlying inheritance of characteristics and termed it as "cell elements"[2]. Johnassen in early twentieth century thought of the word "gene" and then the new evolution started leading to the new science of genetics. At that time, it was perceived in a narrower sense as only a part of biology. In 1940s the term "gene" was coined which was known as "unit of inheritance"[3]. The widely accepted definition of gene was given in 1960s which we accept today also as "a distinct sequence of nucleotides forming part of a chromosome, the order of which determines the order of monomers in a polypeptide or nucleic acid molecule which a cell (or virus) may synthesize[4]". To simplify, "gene is a unit of heredity which is transferred from a parent to offspring and is held to determine some characteristic of the offspring."

[1] indigen.idib.in
[2] Mendel G., 1866. Versuche über Pflanzen-Hybriden. Verh. naturf. Ver. Brünn 4: 3–47.
[3] Johannsen W., 1926. Elemente der exakten Erblichkeitslehre, Ed. 3rd Gustav Fischer, Jena. [Google Scholar]
[4] Portin, Petter, and Adam Wilkins. "The evolving definition of the term "gene"." *Genetics* 205.4 (2017): 1353-1364.

The evolution of genes was more clearly defined in four phases as four eras of genetics as follow: -

- It established the cellular basis of heredity that is chromosomes
- in this phase molecular basis of heredity was defined that is DNA.
- In this phase discovery was made on the recombinant DNA technologies and invented the cloning and sequencing of the DNA.
- The last phase has been demonstrated by first genes and followed up by genomes.

1.1.2 Describing the concept of genome

Genome in the field of biology is defined as "**genetic material** of an organism. It consists of DNA (or RNA in RNA viruses). The genome includes both the genes (the coding regions) and the noncoding DNA, as well as mitochondrial DNA and chloroplast DNA"[5]. DNA stands for Deoxyribonucleic acid it was identified by Friedrich Miescher.[6] DNA is a fundamental building block of all life. We can think of DNA as a set of letters that form sentence, sentence forms paragraph and paragraph form the book, the book then be considered as an individual.

1.1.3 Unfolding the Genetics

A genome is denoted as the complete set of DNA of any organism, including all of its genes. When it was compared to genetics, which precisely is the study of the gene of any individual and the role of genes in the inheritance whereas the aim of genomics is the collective characterization and quantification of all of an organism's genes, their interrelations and influence on the organism.[7] Genomics is a completely technology driven science and we are getting benefit from its extraordinarily fast development. The core of genomics lies in sequencing, which is defined as the process of determining the nucleic acid sequence. It includes any method or technology that is used to determine the order of the four bases: adenine, guanine, cytosine, and thymine.[8] So it is all DNA that is there in your chromosomes. Genome varies from human to human and it carries a lot of information to make

[5] Burger, Gertraud, Michael W. Gray, and B. Franz Lang. "Mitochondrial genomes: anything goes." *Trends in genetics* 19.12 (2003): 709-716.
[6] Dahm, Ralf. "Friedrich Miescher and the discovery of DNA." *Developmental biology* 278.2 (2005): 274-288.
[7] World Health Organization. "Genomics and world health: Report of the Advisory Committee on Health Research." (2002).
[8] Behjati, Sam, and Patrick S. Tarpey. "What is next generation sequencing?" *Archives of Disease in Childhood-Education and Practice* 98.6 (2013): 236-238.

proteins. DNA builds life. A long ago the sequencing of DNA used to be a very tedious and time taking job, it used to take hours to obtain a sequence of may be 20-25 pieces of DNA but with advance technology now it is possible to sequence entire genome of human in just few hours which opens the new dimensions of use of sequencing.

1.1.4 Explaining the Bioinformatics

Genomics is just not based on sequencing; it is spawned other area which is Bioinformatics. **Bioinformatics** is defined as "an interdisciplinary field that develops methods and software tools for understanding biological data, in particular when the data sets are large and complex. As an interdisciplinary field of science, bioinformatics combines biology, computer science, information engineering, mathematics and statistics to examine and interpret the biological data".[9] Genomics is a very new science, even the term Genomics came only about 40 years ago. It got its big break when human genome project was successfully launched in United states approximately 30yrs ago.

Genomics and Bioinformatics has a tremendous role in understanding the infectious disease and its impact on humans ranging from viral to parasite to bacterial. It is also recognized broadly in the studies for host pathogen reactions and diagnostic makers for many ailments.[10] Today it is not only limited to the field of biology. Genomics revolution is now taking place in the world like digital revolution. Sequencing of human genome used to cost more than a million of US dollars till 2016[11] which further came down to 1000 US dollars and even lesser than that now. It thus opens new dimensions in this field including law.

When the cost comes down, we are better placed to work on more genomes. Genomes are uncountable and does not have any correlation with the size of the individual, for example a banana has more genome than a human. This area of genomics is known as Black Matter as a lot of things are not known in this field.

[9] Lesk A.M. "Bioinformatics" Encyclopedia Britannica. Retrieved 17 April 2017 (26 July 2013).
[10] Bah, Saikou Y., et al. "Highlights on the application of genomics and bioinformatics in the fight against infectious diseases: challenges and opportunities in Africa." *Frontiers in genetics* 9 (2018): 575.
[11] Gersbach, Charles A. "Genome engineering: the next genomic revolution." *Nature methods* 11.10 (2014): 1009.

"Central Dogma[12]" is a very important concept for biologists, which states that your gene decides what you are. DNA when readied by an enzyme get converted into protein. DNA is present in every cell of human body and it signals the cells to do what it is supposed to do. The replicating units of protein are amino acids which are folded up in a three-dimensional helix. DNA is present in every unit from noticing some danger to running away from the situation whatever works to govern everything worked well because of proper channel of DNA. In other words that all is governed by Central Dogma.

GMO "Genetically Modified Organism[13]" a beautiful area developed by genetic engineering, these are the organisms or the plants who are modified by altering their genome by genetic engineering. Its major use is in modifying plants to suit the environmental conditions or bacteria to produce insulin for diabetes. When genetically modified organism is designed the scientists are not sure about which trait is going to confer, whether they are bad traits or the good traits[14]. Although it is a very carefully controlled process but what will be coming out remains unknown. Till now there is no evidence that GMOs causes human health consequences but again it opens a wide area for Law to regulate the GMOs. It is the need of the hour to establish GMO regulatory body under Indian legal framework to avoid and control the negative consequences which are being feared.

1.2.1 Genetics and Criminal Law

In criminal law, *actus reus*[15] and *mens rea*[16] are considered as essential elements of crime. The issue in this scenario arises as to how interplay of genetics and criminal law can be a decisive factor in connection with sentencing because of the defences available in the criminal law. Further genetic evidence can be a factor to conclude whether an action/ offence was committed with a premediated mind.[17] Our prime concern should be to focus on genomic technology in such a way that on basis of DNA database justice can be delivered in criminal justice. We have

[12] Gottlieb, Gilbert. "Normally occurring environmental and behavioural influences on gene activity: From central dogma to probabilistic epigenesis." *Psychological review* 105.4 (1998): 792.
[13] National Research Council. *Field testing genetically modified organisms: framework for decisions*. National Academies Press, 1989.
[14] Gachet, E., et al. "Detection of genetically modified organisms (GMOs) by PCR: a brief review of methodologies available." *Trends in food science & Technology* 9.11-12 (1998): 380-388.
[15] Williams, Bernard. "The Actus Reus of Dr. Caligari." *University of Pennsylvania Law Review* 142.5 (1994): 1661-1673.
[16] Sayre, Francis Bowes. "Mens rea." *Harvard Law Review* 45.6 (1932): 974-1026
[17] Cutter, Anthony Mark. "To clear or to convict? The role of genomics in criminal justice." *Genomics, Society and Policy* 2.1 (2006): 1-15.

seen several times that while giving a verdict in a criminal case the terms like sudden and grave provocation, heat of passion, situational factors and cold-blooded murder are used by the courts. These terms play a role of major decisive factor at the time of sentencing. Genetics can be a very helpful tool here as it can unfold the behaviour of an individual expected in a certain situation.

1.2.2 Forensics genetics

With the advancement of genomic technology, it is now possible to assess and envisage the physical traits of a person during the investigation where the offence has been committed by unknown[18]. The information gathered from DNA can lead to narrow down the number of suspects creating more chance for a successful investigation. As far as a trial in a court is concerned, they have their guiding factors to consider a piece of evidence as admissible or inadmissible. Forensic genetics is a branch of modern science that deals with the application of genetic knowledge to the legal proceedings.[19] It applies the current medical knowledge to the field of legal framework. In the cases of rape, the prosecutrices when required to go under a medical examination where the medical practitioner collects the semen of the accused if available. Further when the accused is arrested the investigation officer is required to obtain his DNA sample. It is then that both the samples are sent to a forensic lab for evaluation and based on it an FSL report is prepared. The said report plays a big role to ascertain the commission of rape by the accused.

1.2.3 Privacy and Genetics

In April 2019, a government funded project namely Indigen genome was launched in India. This exercise resulted in sequencing more than a thousand people from different ethnicities. The main purpose behind this exercise was to create an exclusive genome database for India[20]. This database is expected to improve our ability to diagnose, prevent and treat diseases affecting the Indian population. In India there exists no personal data protection bill. However, in the previous year i.e.2019 it was expected that the parliament would tabled the personal data protection bill. This bill is in the process of becoming a law. It is very essential to make sure

[18] Kayser, Manfred, and Peter De Knijff. "Improving human forensics through advances in genetics, genomics and molecular biology." *Nature Reviews Genetics* 12.3 (2011): 179.
[19] Medical definition of forensic genetics WILLIAM SHIEL JR.

[20] *Id*. at 1

that the data of an individual should be used for limited purposes and does not encroach upon the privacy of an individual.

Recently the supreme court of India held in the case of justice K.S. Puttaswamy (retried) v. Union of India and others. That right to privacy is a fundamental right under the constitution of India.[21]

1.3 Problem of the study

- The advancement in the knowledge about the working of the human genome has opened the greater understanding of the role of genetics, it gives an insight into the ways in which genomics might influence human behaviour. As scientific knowledge about genetics continuous to develop, lawyers from various practice areas has caused increase intersection of law and genetics.
- The culprits of serious crime often leave genetic material behind at the scene of crime or on the body. The state crime lab often able to extract DNA profile form that genetic material. These genetic materials cannot be used to identify the perpetrator of crime unless they also have sample from known individuals.
- The genomic information data has opened the scope of its use in research and other similar areas. The privacy law in addition to the privacy of information, privacy of biological samples, genetic test result and genetic modification has raised the ethical and legal issues apart from the issues of excess control, retention, uses and ownership as an area of concern.

1.4 Aims and Objectives

- To explain to the basic genomic research from the perspective of law
- To explore the relationship between genomics criminal law.
- To explore the relationship between the genetics and forensics.
- To consider the ethical issues that can come up in front of Indian criminal courts, and to analyse the laws to be reformed to match the pace with rest of the world.
- To establish the need of the informed consent for the researches in genetics.

[21] (2017) 10 SCC 1

1.5 Hypothesis

The hypothesis for the research is the launching point which provides a specific path to the process of research. They provide a tentative explanation of the issues at hand in the research and guide the research. For this research, the hypotheses have been formulated that, are following: -

- *"Existing laws of India are not sufficient to deal with legal issues that may arise in the field of criminal law keeping in mind the advancements made in the field of genomics"*
- *"There is a need of separate regulatory body which can formulate and enforce laws for genomics in order to balance the rights of an individual and the state"*
- *"DNA database should be divided in various levels i.e. national, state and local to utilise it effectively in criminology, forensics, and issues covering privacy of individuals"*
- *"Ethical and social implications of genomics in laws is an area of concern"*

1.6 Research Questions

- What is the definition of genetics and how it intersects with the field of law?
- What is the importance of genetics in forensics and criminal law?
- What are the privacy, legal and ethical issues involved?

1.7 Research Methodology

The research methodology for this study will adopt historical and analytical approach. The sources would be mainly secondary like books, related published and unpublished work, magazines, newspapers, press circulars, various acts, and legislations. Provisions of various international instruments, practitioner's notes, jurisprudential inputs available both online and in accessible hard form will also be used to obtain the required data.

Chapter II: Review of literature

2.1 Background of genetics

In 1909 Wilhelm Johannsen introduced the term gene. Gene is defined as the series of nucleotides appear in DNA or RNA which form the final gene product[22]. During the process of gene expression, the DNA first gets copied to RNA then leads to formation of protein that is responsible for the functions in body. The genes get transferred from the parents to their offspring carrying the various traits of the family. Some of the traits are visible like hair colour, eye colour, body structure while some cannot be seen by eyes such as blood group, genetic causes of diseases etc. Genes when acquire mutations, leads to different variations in its sequence, known as 'alleles'. These slight difference in genes leads to different traits in humans.

Deoxyribonucleic acid or DNA is a molecule composed of chains of nucleic acid coiled around each other in a double helix[23]. It carries all the information and instructions for the functioning of human body. Each organism has DNA from animal to plants or from insects to microbes. Nucleic acids are one of the major forms of life. DNA was isolated by Friedrich Miescher in 1869, whereas its structure was studied by James Watson in the year 1953[24].

The term genome was given by in year 1920 by Professor Hans Winkler[25]. In biology genome is known as the genetic material of an organism. It comprises of DNA; it contains both the type of coding DNA (genes) and noncoding DNA[26]. Genomics is one of the most powerful newly developed science, which is the study of genomes. It is the study of precisely measuring the activities of all genes at the same time. Once we measure the activity of genes, we can use that information in areas of health, food, and energy. The term genomics was coined by Tom Roderick in year 1986[27]. Genomics is used in healthcare for the diagnosis of diseases by using gene as markers or for understanding the impairment in biological system that causes disease. Also, to find out what is gone wrong at level of genome by bringing the

[22] Pearson, Helen. "What is a gene?." (2006): 398.
[23] James, Havey M. "Overview of Deoxyribonucleic Acid (DNA)."
[24] Noble, Denis. "Genes and causation." *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 366.1878 (2008): 3001-3015.
[25] Winkler, Hans. "Verbreitung und Ursache der Parthenogenesis im Pflanzen-und Tierreiche." (1920).
[26] Pevsner, Jonathan. *Bioinformatics and functional genomics*. John Wiley & Sons, 2015.
[27] Yadav, Satya P. "The wholeness in suffix-omics,-omes, and the word om." *Journal of biomolecular techniques: JBT* 18.5 (2007): 277.

pieces together that ultimately causes disease. These insights are used to develop cures for various diseases. In the area of energy, genomics is being used to breed plants that can be converted into the form of bioenergy. To use genomics to improve productivity in plant, a genomic and plant expert is required. Likewise, if genomics is to be used in understanding human brain function, an expert in neuroscience and in genomics is required. This fundamental science brought together other disciplines making it a multidisciplinary approach.

2.1.1 Behavioural Genetics

Humans are extraordinarily diverse; we differ from each other on many traits. Some of us are all, others are short, some are mesomorphic whereas some are endomorphic, some of us suffer psychotic illness where others live life without any mental health issue. Researchers from last many years are working on these human diversities. One point where they agree is origin of human diversities are not only in physical traits but in psychological traits as well. Moreover, two family members likely to be similar on many physical traits. Humans evolved cognitive processes favours uniformity and solidity. On the other hand, these processes are incompatible with socially diverse world[28]. In multiple researches is has been seen that humans are inclined to react negatively to threats. However, civilization can coaster peaceful coexistence of human despite of diversities[29].

2.1.2 Diversification of Genetics

Charles Darwin was the first person to talk and to publish the theory of evolution in his book 'origin of species' in year 1859. This theory was widely accepted by the scientific society in the year 1870.[30] Evolution is defined as the change the heritable characteristics of biological population over successive generations. During reproduction, the characteristics of parents are passed on to the offspring. The diversity in characteristics occurs due to mutation of the gene. The diversity is present in nature not only in humans but in animals, insects, plants, and

[28] Crisp, Richard J., and Rose Meleady. "Adapting to a multicultural future." *Science* 336.6083 (2012): 853-855.
[29] Ramos, Miguel R., et al. "Humans adapt to social diversity over time." *Proceedings of the National Academy of Sciences* 116.25 (2019): 12244-12249.
[30] Darwin, Charles, and Alfred Russel Wallace. "Evolution by natural selection." *Evolution by natural selection.* (1958).

molecules too[31]. The basic physical and functional unit of heredity is gene. A gene contains many DNAs. Genes vary in size in humans from hundreds to millions. A human has 20000 to 25000 genes[32]. The human has two copies of gene coming from each parent. According to human genome project most of the gene are similar in humans and less that 1percent are slightly different which gives different characteristics and distinct features to humans.

Galton Darwin gave the concept and the definition of behavioural genetics, he studied 4000 men and their relatives, he found out that eminence runs in families and a relative of eminent person are also eminent. This theory believed in the concept of nurture not only nature[33]. Although he had to counter the arguments against the explanation of aggregation. Galton established the field of individual differences in behavioural genetic psychology. Henry Goddard failed his theory at that time by bringing in the concept of IQ (Intelligent Quotient)[34]. where Galton believed in genetic influences on behaviour, Goddard used to believe in at the time of conception the behaviour of an individual is sealed. Galton introduced the term 'Eugenics' i.e. well human.

'Central Dogma' a term given by Francis Crick in 1957. It stated that "once information passed into protein it cannot get out again" which means that information can be transferred from DNA to RNA to protein, but it cannot be transferred from protein to protein. Information hereby means the chain of the nucleic acid[35]. It describes how genetic information flows form DNA to process of forming protein. This process is also known as gene expression. This is present and known by all the kinds of life known on earth, from microorganisms to humans. Measuring the gene expression gives lots of relevant information required in molecular biology, identification of cell susceptibility to infection, viral resistance to drug, mutation in gene strands are commonly used areas.

2.1.3 DNA sequencing and application

[31] Hall & Hallgrímsson 2008, pp. 3–5
[32] https://ghr.nlm.nih.gov/primer/basics/gene
[33] Plomin, Robert, and Richard Rende. "Human behavioral genetics." *Annual review of psychology* 42.1 (1991): 161-190.
[34] Zenderland, Leila. "The debate over diagnosis: Henry Herbert Goddard and the medical acceptance of intelligence testing." (1987).
[35] Coll, Cynthia Garcia, Elaine L. Bearer, and Richard M. Lerner. *Nature and nurture: The complex interplay of genetic and environmental influences on human behavior and development*. Psychology press, 2014.

DNA sequencing is the process of determining the sequence of nucleic acid present in any DNA[36]. It is the basic step required for the medical research and forensics. This step is required to study the mutations in the DNA of any organism. It has its wide application in the field of virology, medicine, and forensics. The era of genome sequencing has started now. The major challenges come while widespread sequencing of individual. However, the advancement in the field of bioengineering have made it possible to understand the fundamental basics for the inheritance of diseases which is in turn a great achievement in medical field. After ten years of era of completion from the complete sequencing of human genome, we are now in an era where genetic information might be used by medical researchers out from the completion of the human genome sequence, we are about to enter an era in which a vast amount of sequencing information will be available to medical researchers and, ultimately, health care professionals. It is incumbent upon physicians and scientists as stewards of this technology to ensure that high quality sequence data is incorporated appropriately into research and clinical endeavours. DNA sequencing is included in the field of Bioethics[37] since 1970.

2.1.4 Bioethics

Bioethics deals with the ethical issues arising out of relationship of biology on one hand and any other discipline like law, life sciences, philosophy, medicine, and politics on the other[38]. Genetic discrimination is one of such issue. In united states, genetic information non-discrimination act (GINA) bars the use of genetic information in employment and health information. The supreme court of California in a landmark judgement titled as John Moore, Plaintiff and applicant, v. the Regents of the university of California et al., defendants and respondents[39] dealt with the bioethical issue of property rights to cells taken by doctors or researchers as a sample. the brief facts of the case are that in 1976 physician David Golde who was a cancer researcher at UCLA medical centre had treated john Moore for hairy cell leukaemia. Golde and UCLA commercialised Moore's cancer cells by developing a cell line. The California supreme court ruled that since Moore had discarded his blood and tissue

[36] Behjati, Sam, and Patrick S. Tarpey. "What is next generation sequencing?." *Archives of Disease in Childhood-Education and Practice* 98.6 (2013): 236-238.
[37] Sass, Hans-Martin. "Fritz Jahr's 1927 concept of bioethics." *Kennedy Institute of Ethics Journal* 17.4 (2007): 279-295.
[38] Marco, Guy A. *The American public library handbook*. ABC-CLIO, 2012.
[39]

samples and waived his claim as personal property, therefore, he is not entitled to have a share in the profits earned due to commercialization as research derived from his cells. However, while it was an obligation on the part of the physician to reveal any financial interest derived from the tissue of Moore. The court also observed had the disclosure of financial interest was made by the physician at an early stage then the Moore would have been in a better position to bring a claim for any injury sustained by him. Notably, justice Arabian stated that the present case involves deep moral, religious and philosophical issues that could not be decided by a court. In India, the legislature would be well advised to treat the challenge of Bioethical issues by framing appropriate laws. Recently Delhi high court in M/S India Insurance v. jai Parkash Tayal[40] held that the health insurance companies cannot exclude genetic disorder under the garb of exclusionary clause as it is in violation of Article 14 as well as Article 21 of Indian Constitution. The court also observed that there are certain traits which may cause abnormalities and the research is being carried out about genetic disorders worldwide to develop effective drugs to cure them but at the same time it is also a matter of debate. It is pertinent to mention here that the supreme court of India has partially stayed the judgement of Delhi high court in the United India In Insurance v. jai Parkash Tayal[41].

2.1 Genetics and Criminal law

Criminal law was introduced by Britishers, in India in the year 1860. Criminal laws in India has 3 hands as Indian Penal Code, Indian Evidence act and Code of Criminal Procedure. Mens rea is the dealing with mental element of the crime can also be defined as the objective what was behind the time. Whereas *actus reus*, is the physical part of the crime or the act that a criminal has done physically. *Actus reus,* comprises of three elements behind the crime[42]. First is element of conduct, the element that criminal has done as crime, like in rape cases conduct of element is sexual intercourse or in the case where criminal has injured someone during driving, driving is the conduct of element. The second element is, element of attendant circumstances element, clearly defined as the thing that has to exist at the time criminal does the act of cruelty like in juvenile sexual harassment cases if the criminal is under the influence of some addictive substance that will be attendant circumstance element. The last element is

[40] RFA 610/2016 and CM nos. 45832/2017
[41] SLP(c) No.29590/2018
[42]Katz, Leo. *Bad acts and guilty minds: Conundrums of the criminal law*. University of Chicago Press, 2012

result element which is the result what has happened in crime like rape, murder, drinking and driving and causing accidents etc.

In India's context there is almost no research to establish the relation between the elements *actus reus* and genes. Taking an example of alcohol as the element attendant circumstances, as it is established that influence of alcohol on anyone and its time of metabolism is governed by its genes or the situation tackling ability is correlated to the gene. So, the jurisdiction comes under the state of dilemma whether the person was under the influence of alcohol at the time of driving or not. Another point comes in the result element. As gene carries the tendency of homicide so whether it is to be consider under the criminal procedures or not because no one decides the gene he is carrying.

There is one more situation where genetic evidence bears directly on the conduct elements that is known as DNA matching for example taking the fingerprints from the crime scene and matching it with the suspect. It is done by DNA profiling. DNA profiling or fingerprinting of DNA is a process of understanding and applying the DNA characteristics. DNA profiling is a forensic technique in the criminal investigations to compare DNA profile of criminal suspects to the crime scene. DNA profiling is being challenged in lots of cases for not matching complete DNA profile.

A famous case which established the correlation of genomics and law was of Mr. Waldroup, in year 2006 he killed his wife and a friend of his wife when she came to see him to drop her children. At the time of his trial it came into limelight that Mr. Bardley Waldroup has a MAOA gene in his genome and this gene is responsible for the criminal behaviour as he has shown. After this incidence, the study was taken further and found MAOA gene in 400 more criminals. It was then becoming more evident gene has a correlation with the criminal tendencies of a person.

Actus reus- Action or conduct that is a constituent element of a crime, has a relation with the genomics. There is a strong need to study the genome and behaviour of that gene in the criminal mindset of India. When we talk about *mens rea* or the mental state in the crime there is a strong need of a person to do crime with a certain mental setup. As the genes have a relationship with the behaviour of a person it becomes more evident to show and to study the genomics in the Indian legal framework.

In 2012, a committee headed by Ajit Prakash Shah suggested that India does not have any safeguard to prevent illegal DNA data collection. The committee also suggested that a citizen should be armed with right to appeal if his data is retained. The committee was of the view that the samples of a citizen under trial can be obtained after consent. Apart from that these sample could also be obtained from crime scenes. The report said that the data should be destroyed after serving the purpose for which it was obtained. In the same year Lok Niti foundation, which is a nongovernmental organisation had filed a PIL[43] in the apex court praying that the government should present a blueprint to address the problem of unclaimed dead bodies which are in thousands annually. The government in reply filed its affidavit and stated that they will constitute a national database. Notably in the same affidavit the government also stated that they do not have enough trained personnel to work out the goal of establishing a national database. The concerned bill was due to be presented in March 2015, but due to privacy concerns it was halted.

2.2 Forensics Genetics

Forensics genetics was limited to the use of DNA in criminal investigations and civil court cases, now it is going to much wider aspects of proving crimes such as bioterrorism, bio crimes, identification of fraudulent food composition as other uses. This is now possible to explore these fields with the use of DNA material taken from animal species, plants, or microbes[44]. When we think about DNA investigations there are two main forms, using DNA as investigate leads and DNA when it will be used as evidence. CODIS combined DNA index system is the genetic database of United States which is maintained by FBI federal bureau of investigations. CODIS markers are the piece of information that can be taken form the crime scene and to be matched with the suspects DNA. The uniqueness and the individuating characteristics of the genetic markers is such high that it can be matched with the suspect's DNA for the evidence. DNA profiling allows the identification of persons already known to investigating authorities and that makes easy for the investigating team to reach the suspects. other developments in forensics are supporting the links between the criminal acts and the

[43] Writ petition (civil) no.491 of 2012

[44] Arenas, Miguel, et al. "Forensic genetics and genomics: Much more than just a human affair." *PLoS genetics* 13.9 (2017).

behaviour of the criminals[45]. The reduc0ed time to generate the required information from DNA making it more achievable for investigating agencies to use forensics.

There are many reasons for using DNA leads for criminal cases, physical traits, appearance, genetic ancestry are a few of them which makes it very easy for the legislature to give punishment to the actual offender. Face develops in gestation and there is vey wide ranging effects of gene on facial expressions. The studies of heredity have already established the facts of environmental and genetic effects on the face. 'Facial Genetics' a new emerging branch of genetics has developed 3D facial shapes form the use of genetic markers[46]. Although the model they are creating is only a predictive model and can be used in future as an important arm of forensics to get a familiar face with the use of this technology. The researcher completely agrees with the different physical traits and lots of work to be done before validating this programme still the future of forensics with genetics can get a new height with this upcoming technology.

Matching pace with rest of the world, it is high time that India should consider building its own DNA database divided into 3 levels i.e. local, state, and national. These databases would be of a great help not only to solve the criminal cases and identify the unclaimed dead bodies but also it will also boost the commercial sector.

2.4 Genetic Privacy

The advancement in technology have appreciably improve the accuracy and the speed in genetic testing. The cost of the genetic testing is reduced from lakhs of rupees to thousands due to evolutions. It thus makes the genetic testing for the new aspects more accessible. DNA of every person is unique, and it is also having some variants in family for certain good characteristics. These concepts lead to many people's claim to privacy protection for their genetic information. It is very natural for an individual to consider his genetic information as private. The definition of privacy has spread its wings in past few decades not only in India but also in rest of the world. The era of internet and communication, technologies have broadened the capacity to share the information. This information also includes sensitive and personal information shared without the concerned individual's consent and knowledge. The

[45] Kayser, Manfred, and Peter De Knijff. "Improving human forensics through advances in genetics, genomics and molecular biology." *Nature Reviews Genetics* 12.3 (2011): 179.
[46] Claes, P., Liberton, D. K., Daniels, K., Rosana, K. M., Quillen, E. E., Pearson, L. N., ... & Tang, H. (2014). Modeling 3D facial shape from DNA. *PLoS genetics*, *10*(3).

balancing of the right of an individual regarding privacy and right of public to access the information is a very challenging task. For this the appropriate legal principles are required to ensure the genetic privacy. The authority of a state to interfere with an individual's genetic disorder is also to be defined even though it involves the field of health, disability, or insurance policies etc. the concept of privacy us very complex. It also includes ethical as well as legal principles. It is expected to acknowledge the magnitude of information about an individual with a very specific and restricted access. According to Anita Allen contemporary issues of bioethics and public policy refers to one of four categories of 'privacy'

- Informational privacy and access to personal information
- Physical privacy and personal spaces
- Decisional privacy with personal choice and interference by government and third party
- Proprietary privacy and ownership of interest in human personality.[47]

Our focus should be on the question as to how much a law can control the people regarding their privacy of genetic information. The law must not be illusory, and it must be able to ensure that no harm will be caused to the individual due to the data provided by him.

Recently in the case of justice KS Puttaswamy v. Union of India[48] the apex court in this landmark case held that right to privacy is a part of an individual's fundamental freedom or liberty guaranteed under article 21 of Indian Constitution. Article 21 of Indian constitution says that "no person shall be deprived of his life or personal liberty except according to procedure established by law". It is very important to mention here that the court while delivering he judgement has observed that the right to privacy is not an absolute right and the state is allowed to put reasonable restrictions provides by law in the light of a state's legitimate aim which should be unbiased and within the ambit of constitutional law itself. [49]

[47] Anita, L. "Genetic Privacy: Emerging Concepts and Values." *Mark A R. Genetic Secrets: Protecting Privacy and Confidentiality, in the Genetic Era* (1997).
[48] Id at p.7
[49] Id at p.7

Tentative chapterization

Chapter 1: Introduction: Definition and concepts

This chapter sets the background of the present study. It will outline the definition of gene, genome and genetics. It will cover the basic knowledge of structure and function of genome, and the understanding of use of genomics in various fields. It will also briefly outline the correlation between genomics and current Indian criminal laws.

Chapter 2: Genetics and Criminal Law

In this chapter the discussion of relationship of genomics and law will be outlined. It will also go on to explore the Indian criminal justice system and how the use of genomics might improve or harm the criminal law. It will also review the types of genetic evidence that might impact criminal law.

Chapter 3: Genetics and Criminal procedure

In this chapter the conceptualization of individual's DNA in criminal law will be covered. It will further explore the circumstances in which government might have interest in DNA of a person. It will outline how DNA is obtained, examined, and processed in criminal investigations.

Chapter 4: Forensics Genetics

It will be applied to explore use of genomics to estimate ancestry, to predict the physical characteristics of a person and to review the current standards for utilizing it as genetic evidence in criminal cases. In this will be further exploring the best methods to utilize the genomics evidence under current legal standards.

Chapter 5: Genetics and Privacy law

In this chapter will examine the major issues related to privacy and genomics and how the privacy of genomic information is regulated. It will also outline the need of major genomic privacy regulations and need to examine the laws for penalties of violation of genomic privacy regulations.

Chapter 6: Conclusion

This last chapter will summarise the major findings of the present study in context of the research questions sought to be answered. This chapter would also seek the suggestions for better Indian legal framework in criminal laws with genetics.

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Forensic Genetics: its application in criminal law

By

Abhinav Vardhan Sharma

Registration number: 2K20-PFL-002

Under the supervision of

Dr.Somdutt Bhardwaj

Abstract

Genetics is generally used as a multidisciplinary science approach to address the challenges of legal arena. Genetics is a young science. The *actus reus* and *mens rea* are thought to have a correlation with certain genetic factors and that information can be taken out with the use of science of genomics. 'Behavioural genetics',a term if applied and studied properly can lead to reduced criminal activities and in turn India can come up as a safe place to live in.Forensic genetics now not only related to the DNA fingerprinting but taken up the next level by designing the 3d face models by the information taken out by certain cells only. The question of privacyconcerns and the ethical issues that can arise because of this technology also require to be answered from the angle of law.

The purpose of this study is to find out the possible answers to these issues keeping in mind the limitations and the requirement of regulations for the hidden issues that can come up with the advancements in the field of criminology.

Key Words: DNA, RNA, gene, GINA, HIPPA and GMOs.

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